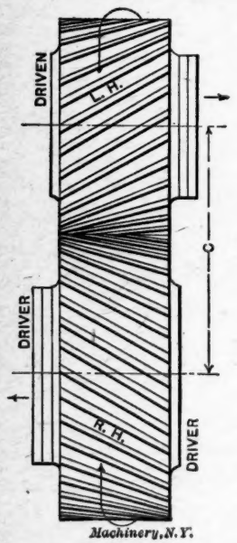
Shafts Parallel, Ratio Unequal, Center Distance Exact



Given or assumed:

1. Position of gear having right- or left hand spiral depending upon rotation and direction in which thrust is to be be received. (See thrust diagram.)
2. C = exact center distance = pitch diameter.
3. P_n = normal pitch (pitch of cutter).
4. N = number of teeth in large gear.
5. n = number of teeth in small gear.

To find:

1. $\cos \alpha = \dfrac{N + n}{2\, P_n\, C}$
2. D = pitch diameter large gear $= \dfrac{N}{P_n \cos \alpha}$
3. d = pitch diameter of small gear $= \dfrac{n}{P_n \cos \alpha}$
4. O = outside diameter of large gear $= D + \dfrac{2}{P_n}$
5. o = outside diameter of small gear $= d + \dfrac{2}{P_n}$
6. T = number of teeth marked on cutter (large gear) $= \dfrac{N}{\cos^3 \alpha}$
7. t = number of teeth marked on cutter (small gear) $= \dfrac{n}{\cos^3 \alpha}$
8. L = lead of spiral (large gear) $= \pi\, D \cot \alpha$
9. l = lead of spiral (small gear) $= \pi\, d \cot \alpha$

Example

Given or assumed:
1. Fig. 1 (thrust diagram). 2. $C = 18.75$ inches. 3. $P_n = 4$. 4. $N = 96$. 5. $n = 48$.

To find:

1. $\cos \alpha = \dfrac{N + n}{2\, P_n\, C} = \dfrac{96 + 48}{2 \times 4 \times 18.75} = 0.96$. $\therefore \alpha = 16° 16'$.
2. $D = \dfrac{N}{P_n \cos \alpha} = \dfrac{96}{4 \times 0.96} = 25$ inches; 3. $d = \dfrac{n}{P_n \cos \alpha} = \dfrac{48}{4 \times 0.96} = 12.5$ inches;
4. $O = D + \dfrac{2}{P_n} = 25 + \dfrac{2}{4} = 25.5$ inches; 5. $o = d + \dfrac{2}{P_n} = 12.5 + \dfrac{2}{4} = 13$ inches;
6. $T = \dfrac{N}{\cos^3 \alpha} = \dfrac{96}{(0.96)^3} = 108$ teeth; 7. $t = \dfrac{n}{\cos^3 \alpha} = \dfrac{48}{(0.96)^3} = 54$ teeth;
8. $L = \pi\, D \cot \alpha = 3.1416 \times 25 \times 3.427 = 269.15$ inches.
9. $l = \pi\, d \cot \alpha = 3.1416 \times 12.5 \times 3.427 = 134.57$ inches.

Contributed by James H. Carver
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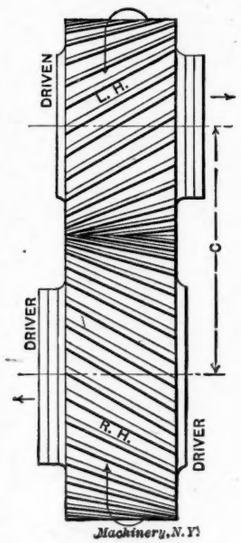
Shafts Parallel, Ratio Unequal, Center Distance Approximate



Given or assumed:

1. Position of gear having right- or left-hand spiral depending upon rotation and direction in which thrust is to be received. (See thrust diagram.)
2. C_a = approximate center distance.
3. P_n = normal pitch.
4. N = number of teeth in large gear.
5. n = number of teeth in small gear.
6. α = angle of spiral.

To find:

1. D = pitch diameter of large gear $= \dfrac{N}{P_n \cos \alpha}$
2. d = pitch diameter of small gear $= \dfrac{n}{P_n \cos \alpha}$
3. O = outside diameter of large gear $= D + \dfrac{2}{P_n}$
4. o = outside diameter of small gear $= d + \dfrac{2}{P_n}$
5. T = number of teeth marked on cutter (large gear) $= \dfrac{N}{\cos^3 \alpha}$
6. t = number of teeth marked on cutter (small gear) $= \dfrac{n}{\cos^3 \alpha}$
7. L = lead of spiral on large gear $= \pi\, D \cot \alpha$.
8. l = lead of spiral on small gear $= \pi\, d \cot \alpha$.
9. C = center distance (if not right vary α) $= \frac{1}{2}\,(D + d)$.

Example

Given or assumed:
1. Fig. 1 (thrust diagram). 2. $C_a = 17$ inches. 3. $P_n = 2$. 4. $N = 48$. 5. $n = 20$.
6. $\alpha = 20$ degrees.

To find:

1. $D = \dfrac{N}{P_n \cos \alpha} = \dfrac{48}{2 \times 0.9397} = 25.541$ inches. 2. $d = \dfrac{n}{P_n \cos \alpha} = \dfrac{20}{2 \times 0.9397} = 10.642$ inches.
3. $O = D + \dfrac{2}{P_n} = 25.541 + \dfrac{2}{2} = 26.541$ inches. 4. $o = d + \dfrac{2}{P_n} = 10.642 + \dfrac{2}{2} = 11.642$ inches.
5. $T = \dfrac{N}{\cos^3 \alpha} = \dfrac{48}{(0.9397)^3} = 57.8$, say 58 teeth. 6. $t = \dfrac{n}{\cos^3 \alpha} = \dfrac{20}{(0.9397)^3} = 24.1$, say 24 teeth
7. $L = \pi\, D \cot \alpha = 3.1416 \times 25.541 \times 2.747 = 220.42$ inches.
8. $l = \pi\, d \cot \alpha = 3.1416 \times 10.642 \times 2.747 = 91.84$ inches.
9. $C = \frac{1}{2}\,(D + d) = \frac{1}{2}\,(25.541 + 10.642) = 18.091$ inches.

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